

COMPUTER CONTROLLED MULTI-LINK COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a multi-link administrative telephone and intercom system having automatic as well as supervised call distribution and PBX capability.

2. Description of the Background Art

Dahlquist et al. U.S. Pat. No. 3,809,824 discloses a multi-link private automatic telephone system including "administrative" dial telephones and "staff" dialless telephones. The lifting of a receiver of a dialless telephone produces a visual indication on an annunciator panel. An administrator must respond by dialing the phone number of the dialless telephone in order to establish a communication link. The administrator may also dial other phone numbers to add other telephones to the link to establish a conference call or to permit a conversation between two dialless telephones.

Dahlquist et al. U.S. Pat. No. 4,081,614 discloses a single link telephone system including an "administrative" tone dialing telephone, "staff" dialless telephones, and intercom speakers. The administrative telephone includes a digital display for sequentially indicating the numbers of call-ins from the staff telephones or intercom speakers. To call the first number on the display, the administrator can merely press a single button on the administrative telephone. When a staff telephone or intercom speaker is called, its number is removed from the digital display. Each staff telephone or intercom speaker can transmit a priority call-in signal which places its phone number in the first display position and activates a visual and audible signal to attract the administrator's attention.

Microcomputer control is now being used for multi-link automatic private or private branch exchange (PBX) telephone systems. The microcomputer is used for assigning links to the system, and for diagnostic and reporting functions. A universal problem encountered when employing a microcomputer in an automatic telephone exchange is the interconnection of the microcomputer to the voice switching positions or circuits which connect the telephones to selected audio links. In addition busy signals, ringing signals, and "off-hook" signals must be conveyed between the microcomputer and the telephones. Also, it is desirable to provide flexibility to vary the size of the system and to modify the functions of the different stations. Typically these capabilities have been provided by complex or relatively expensive interface circuitry.

One way of dealing with the microcomputer interface problem is to employ a number of microprocessors which communicate with each other on an asynchronous basis and which are interfaced to an assigned group of stations, as disclosed in Pitroda et al. U.S. Pat. No. 4,289,934. Another known method is to transmit only digital information between the phones as well as the microcomputer, and to provide each phone with audio-to-digital and digital-to-audio converters. This latter technique provides the greatest flexibility, but at a corresponding expense.

SUMMARY OF THE INVENTION

Accordingly, the primary object of the invention is to provide an economical computer controlled multi-link

telephone system that provides great flexibility to vary the size of the system and to modify the functions of the different stations.

A related object of the present invention is to provide an economical and highly flexible multi-link administrative telephone and intercom system having automatic as well as supervised call distribution and PBX capability.

Briefly, in accordance with an important aspect of the invention, the multi-link communication system includes a number of stations and interconnecting audio links under the control of a central computer. Each station is addressable by the computer for connecting selected stations to a selected audio link for establishing audio communication between stations. Each station has at least one corresponding access circuit for establishing an audio connection to a selected or preassigned link, and the connection is maintained by a corresponding memory circuit that is addressable by the computer.

A group of output lines from the computer are used as select inputs to an analog multiplexer connecting a bidirectional control line to the selected access circuit for connecting or disconnecting the corresponding station and also for receiving connect or disconnect requests from the corresponding station.

In a preferred embodiment, the stations include multi-link dial and dialless telephones, single-link dialless telephones, and intercom speakers, in an automatic private branch exchange. Latching relays provide audio connections for speakers and dialless single-link phones, and unbalanced analog transmission gates provide audio connections for multi-link phones. The capabilities for each station are encoded as predefined attributes stored in electrically alterable memory, and the attributes of a selected station are user-programmable by the touch-tone dial of an administrative telephone. Standard and priority call-ins from dialless phones and intercom speakers are identified on a numeric or a graphic display interconnected to the computer by a shielded wire or a shielded balanced pair conveying a pulse-width modulated binary signal.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIG. 1 is a block diagram of a computer controlled multi-link administrative telephone and intercom system according to the present invention;

FIG. 2 is a block diagram of the central components of the system of FIG. 1, including the microcomputer, its interface circuits, and circuits for interconnecting telephone lines to shared speaker lines;

FIG. 3 is an appendage to FIG. 2 and includes a block diagram of a speaker control module;

FIG. 4 is an appendage to FIG. 2 and includes a block diagram of a line-link module for interfacing a number of telephones to a number of audio links;

FIG. 5 is a block diagram showing the use of multiplexed bidirectional control lines for transmitting signals to connect and disconnect a selected phone or speaker, and for receiving signals indicating whether a selected telephone is "on-hook" or "off-hook", and for determining whether a low priority call-in or a high priority call-in has been sent from a selected intercom station;